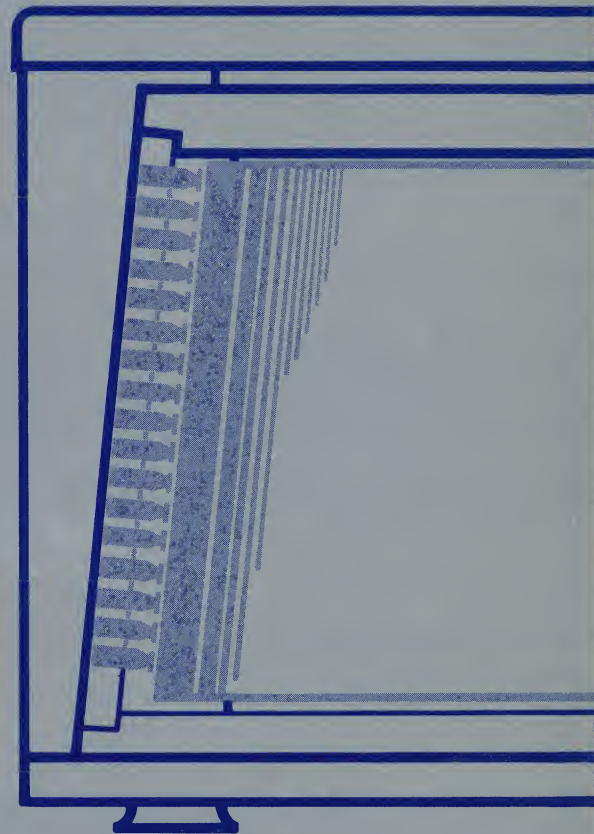


TECHNICAL DATA



**AUTO-LIFT
MAGNETIC
STORAGE
DRUMS**

BRYANT COMPUTER PRODUCTS

A DIVISION OF
XLO
EX-CELL-O CORPORATION

Bryant Auto-Lift + Uni-Just Aerodynamic Heads

AUTO-LIFT MECHANISM

Bryant Computer Products—the largest independent supplier of memory drums—has produced thousands of magnetic storage drums to satisfy both standard and custom requirements in prototype and production quantities. Bryant drums have established an enviable reputation for mechanical excellence, high quality, and reliability at low cost, and have for many years featured patented tapered rotor (truncated cone) construction for ease of head adjustment and maintenance.

In response to computer industry demands for even greater reliability, higher bit density, faster bit rates, and lower cost per bit, Bryant research has developed a flying head drum with Auto-Lift—the ultimate in reliability and maintainability. They have combined the time-proven, Bryant-patented tapered drum with true aerodynamic heads to produce the first simple, fail-safe drum design that eliminates head contact.

Bryant engineers achieved their goal without the use of auxiliary motors, cables, cams, solenoids, or bi-metal components. By designing and developing a simple, self-regulating automatic device for moving the drum along its axis, Bryant engineers have made it possible for the magnetic surface to be brought up to, but not into contact with, the heads during start-up and to be retracted from the heads when stopping. When the drum speed is insufficient to generate a laminar film of air capable of supporting the heads aerodynamically, the drum descends away from the heads. This results in extremely reliable clearance between head and drum surfaces.

HERE'S HOW AUTO-LIFT WORKS—

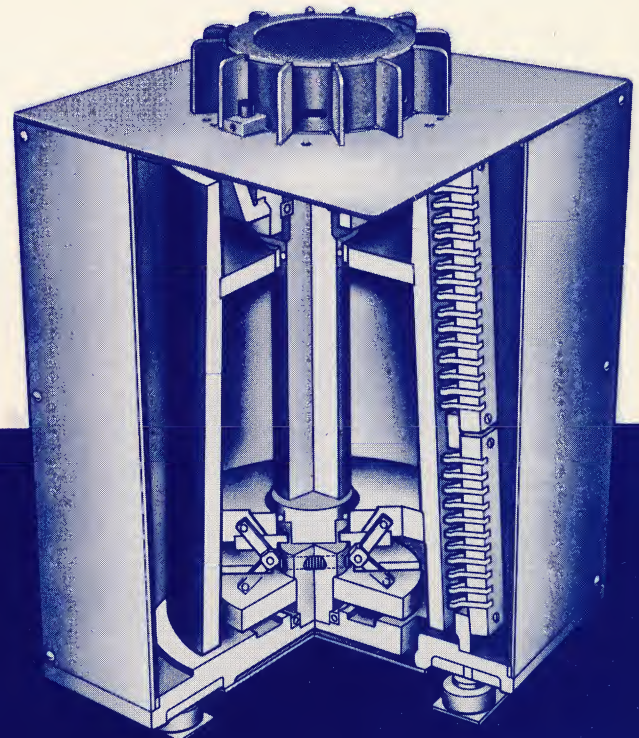
In the static condition, the flying heads are located away from the surface of the tapered drum. The mechanism for moving the drum axially comprises a pair of simple scissor links which are straightened out by centrifugal force as the drum accelerates to approximately 75% of its operating speed. Straightening of the links raises the drum against a precision stop which defines its operating position. Thus, repeatability of track location is *exact*. Spring tension is used to col-

lapse the links and lower the drum as it slows down to approximately 65% of operating speed.

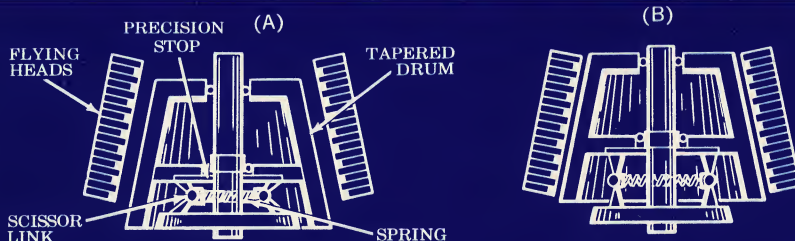
This unique centrifugal mechanism, resembling a fly ball governor, is used in all Auto-Lift drums and functions automatically without operating adjustments for the life of the drum. No auxiliary motors, actuators or external control mechanisms are required, and the unit is largely insensitive to thermal and physical shock.

The Auto-Lift principle used in Bryant drums offers the following exclusive features:

- No head/drum contact.
- Centrifugal lift raises tapered drum to heads at operating speed.
- Tapered drum retracted axially on stop cycle.
- Simple, fail-safe operation regardless of number of heads.
- Auto-Lift maintains head-to-drum spacing.
- Auto-Lift is automatic, requires no external power, controls, or adjustment.
- Auto-Lift unit relatively unaffected by temperature, shock, or vibration.
- Full range of standard sizes and speeds in production.
- Interchangeable production parts throughout.
- All drums expandable to full capacity in field.
- Motor and bearings field servicable without loss of data.



Cross-sectional view of a typical Auto-Lift magnetic storage drum.



Functional diagram showing how Bryant's Auto-Lift mechanism operates. In the stopped—or drum down—position (A), the heads are located about 0.010 inch from the drum surface to ensure against start/stop contact. When the drum moves to its up position (B), the heads are supported on a laminar film of air created by drum rotation.

= Reliability and Maintainability

UNI-JUST AERODYNAMIC HEAD

Total drum system reliability depends not only upon the ability of the drum to operate without head-to-drum contact during start/stop cycles, but also on the ability of heads to fly over a wide range of operating conditions and on the electromagnetic performance of the heads.

Bryant Uni-Just flying heads are truly aerodynamic. They fly stably at all Auto-Lift operating speeds, and over a wide range of shock, vibration, and temperature conditions. Uni-Just heads fly continuously—without skipping or bouncing. Playback signal modulation is virtually eliminated.

The Uni-Just head consists of a pole piece structure encased by a magnetic shield and molded in an aerodynamic pad, as shown in upper figure. A single mechanical design serves all of the standard Auto-Lift drums throughout their speed ranges, simplifying maintenance and reducing cost of production and spare parts inventory.

All magnetic heads exhibit a natural distribution of characteristics. Variations in playback amplitude are compensated for by adjusting the flying positions of the individual heads relative to the drum surface. A wide range of head adjustment is available because of the extremely stable flying characteristics.

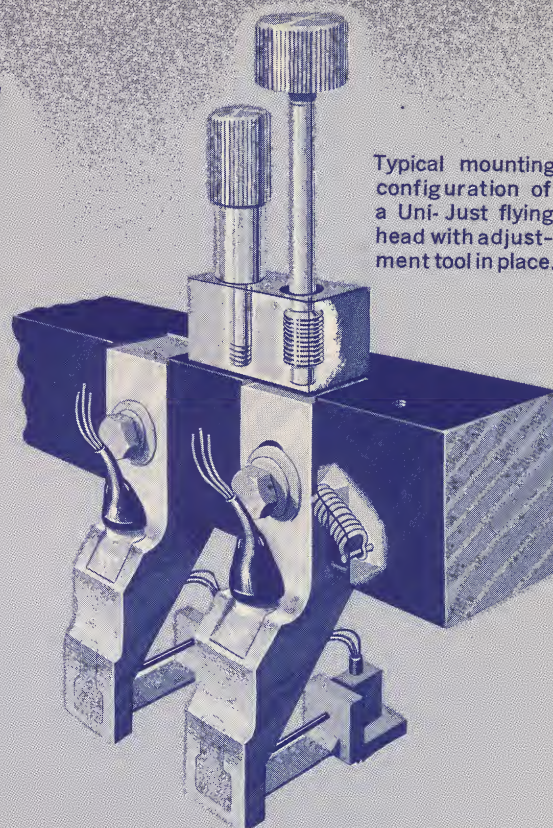
Adjustments are achieved by varying the head preload toward the drum while the drum is rotating. This adjustment is made against a spring mounted in each head body and is locked by a screw. The spring provides fail-safe operation by retracting the head from the drum in the event the set screw is loosened inadvertently.

These superior head features—coupled with the excellent electrical characteristics of Uni-Just heads—produce a standard of performance which is outstanding in terms of resolution, amplitude uniformity, frequency range and reliability. Low-frequency/low-density and high-frequency/high-density (over 500 ppi) applications requiring selective bit alteration or bit interlacing are handled with equal reliability.

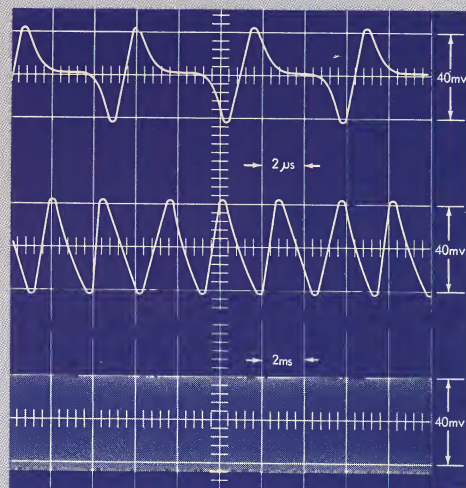
Individual head adjustment is easily made with a simple tool while the drum is operating, as shown in the lower figure. While the head is being set, an oscilloscope monitoring the write-read operations displays a smooth envelope when the head is flying on the laminar film of air created by the drum rotation, as shown in the center figure. When the proper playback is achieved, the locking screw is tightened and the tool removed. To make this adjustment procedure completely fail-safe, the adjustment slot in the head bracket is designed to prevent the free end of the head bracket from contacting the drum.

Bryant Uni-Just Aerodynamic Heads used on all Auto-Lift drums offer the following features:

- True aerodynamic heads fly continuously—no skipping or bouncing.
- Negligible playback envelope modulation.
- Fail-safe individual adjustment of heads.
- Head adjustment and replacement with drum running.
- Full range of frequency and pulse density satisfied by production heads.
- Unlimited recording modes.



Typical mounting configuration of a Uni-Just flying head with adjustment tool in place.



Unretouched oscilloscope display showing playback signal level and resolution for a pattern of alternate ONES and ZEROS (top-waveform) and all ONES (middle waveform). The lack of modulation of the overall envelope (bottom waveform) indicates head is truly flying and not "bouncing" or "skipping" along.

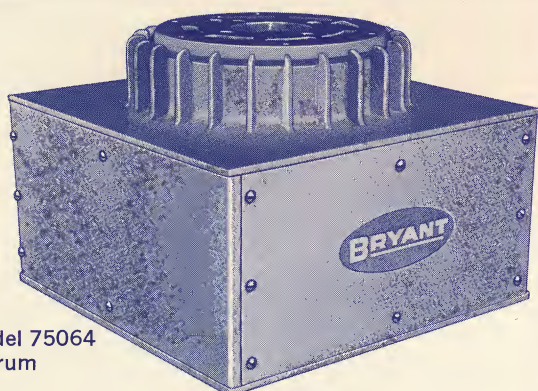


Uni-Just head being set using special adjustment tool.

STANDARD AUTO-LIFT DRUMS

Recommended Maximum Recording Densities

Discrete-Bit Alteration—500 BPI
Block-Format—800 BPI



Bryant Model 75064
Auto-Lift Drum

SERIES 5000

- Average access times as low as 2.5 milliseconds
- Capacities up to 3,617,280 bits
- 5-Inch diameter, nominal

SERIES 75000

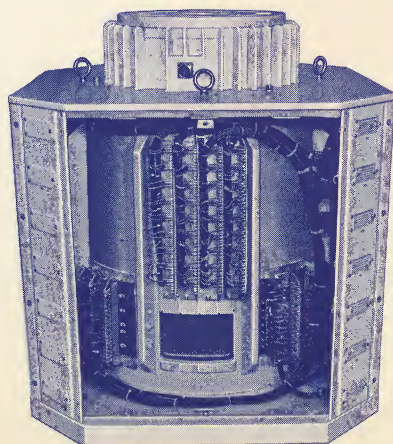
- Average access times as low as 5.0 milliseconds
- Capacities up to 5,425,920 bits
- 7.5-Inch diameter, nominal



Bryant Model 10512
Auto-Lift Drum

SERIES 10000

- Average access times as low as 6.7 milliseconds
- Capacities up to 14,469,120 bits
- 10-Inch diameter, nominal



Bryant Model 185384
Auto-Lift Drum

SERIES 185000

- Average access times as low as 8.35 milliseconds
- Capacities up to 47,587,330 bits
- 18.5-Inch diameter, nominal

AUTO-LIFT MODEL			5064		5128		5256					
PACKING DENSITY (BITS/INCH)			500 ¹	800 ²	500 ¹	800 ²	500 ¹	800 ²				
TRACK CAPACITY (BITS)			7,850	12,560	7,850	12,560	7,850	12,560				
NUMBER OF TRACKS			90	90	156	156	288	288				
DRUM CAPACITY (BITS)			706,500	1,130,400	1,224,600	1,959,360	2,260,800	3,617,280				
ACCESS TIMES ³ (MILLISECONDS) AT THESE STANDARD SPEEDS: ⁷												
3,600 RPM	16.7	} ONE REV AVG {	● ● ● ● ● ●		● ● ● ● ● ●		● ● ● ● ● ●					
4,000 RPM	15.0											
4,800 RPM	12.5											
6,000 RPM	10.0											
8,000 RPM	7.5											
12,000 RPM	5.0											
OVER-ALL HEIGHT (INCHES) ^{4,5}			12½		15		20½					
OVER-ALL WIDTH (INCHES) ⁶			13¾		13¾		13¾					
APPROXIMATE WEIGHT (POUNDS)			75		90		120					
AUTO-LIFT MODEL			75064		75128		75256					
PACKAGING DENSITY (BITS/INCH)			500	800	500	800	500	800				
TRACK CAPACITY (BITS)			11,775	18,840	11,775	18,840	11,775	18,840				
NUMBER OF TRACKS			90	90	156	156	288	288				
DRUM CAPACITY (BITS)			1,059,750	1,695,600	1,836,900	2,939,040	3,391,200	5,425,920				
ACCESS TIMES ³ (MILLISECONDS) AT THESE STANDARD SPEEDS: ⁷												
3,600 RPM	16.7	} ONE REV AVG {	● ● ● ●		● ● ● ●		● ● ● ●					
4,000 RPM	15.0											
4,800 RPM	13.4											
6,000 RPM	10.0											
OVER-ALL HEIGHT (INCHES) ^{4,5}			13		15½		20½					
OVER-ALL WIDTH (INCHES) ⁶			15¾		15¾		15¾					
APPROXIMATE WEIGHT (POUNDS)			90		100		140					
AUTO-LIFT MODEL			10128		10256		10384		10512			
PACKING DENSITY (BITS/INCH)			500	800	500	800	500	800	500	800		
TRACK CAPACITY (BITS)			15,700	25,120	15,700	25,120	15,700	25,120	15,700	25,120		
NUMBER OF TRACKS			156	156	288	288	440	440	576	576		
DRUM CAPACITY (BITS)			2,449,200	3,918,720	4,521,600	7,234,560	6,908,000	11,052,800	9,043,200	14,469,120		
ACCESS TIMES ³ (MILLISECONDS) AT THESE STANDARD SPEEDS: ⁷												
1,800 RPM	33.4	} ONE REV AVG {	● ● ● ●		● ● ● ●		● ● ● ●		● ● ● ●			
3,600 RPM	16.7											
4,000 RPM	15.0											
4,800 RPM	13.4											
OVER-ALL HEIGHT (INCHES) ⁴			18¾		20¼		28½		33¾			
OVER-ALL WIDTH (INCHES) ⁶			17¾		17¾		17¾		17¾			
APPROXIMATE WEIGHT (POUNDS)			155		160		250		265			
AUTO-LIFT MODEL			185128		185256		185384		185512		1851024	
PACKING DENSITY (BITS/INCH)			500	800	500	800	500	800	500	800	500	800
TRACK CAPACITY (BITS)			29,045	46,472	29,045	46,472	29,045	46,472	29,045	46,472	29,045	46,472
NUMBER OF TRACKS			156	156	288	288	440	440	576	576	1024	1024
DRUM CAPACITY (BITS)			4,531,020	7,249,630	8,364,960	13,383,930	12,779,800	20,447,680	16,729,920	26,767,870	29,742,080	47,587,330
ACCESS TIMES ³ (MILLISECONDS) AT THESE STANDARD SPEEDS: ⁷												
1,200 RPM	50.1	} ONE REV AVG {	● ● ●		● ● ●		● ● ●		● ● ●		● ● ●	
1,800 RPM	33.4											
3,600 RPM	16.7											
OVER-ALL HEIGHT (INCHES) ⁴			21½		22½		34½		39¾		58½	
OVER-ALL WIDTH (INCHES)			28¾		28¾		29¾		29¾		29¾	
APPROXIMATE WEIGHT (POUNDS)			325		350		600		800		1000	

(1) Discrete-bit alternation—PM or MRB recording mode. (2) Block-format—PM or MRB recording mode (packing density doubled with NRZ or NRZI recording mode). (3) Speeds and access times do not include motor slip. (4) Measured from base of drum vibration mounts to top of drum motor. (5) Allow approximately four inches additional height for 400-cycle motor. (6) Allow two and one quarter inches minimum clearance for connectors on one side of drum. (7) Maximum frequency capability must be considered when calculating access time and packing density.

Engineering Data

CAPACITY—Nominal 500 bit-per-inch (BPI) packing density determines capacity and frequency for single-bit alteration recording mode. Bit interlacing permits reduction of frequency while maintaining drum storage capacity. Packing densities up to 800 BPI are obtainable using block-format recording.

CLOCKS AND REGISTERS—Number of tracks indicated for each drum includes a minimum of 16 tracks for clocks and registers; additional tracks can be assigned as required. These 16 tracks can be utilized to give various combinations of clocks and registers. For example, assuming one write and one read head were used per register, configurations could be made up of eight clocks and four registers, two clocks and seven registers, and the like. Also, any two adjacent general storage heads can be replaced with one register head. Spacing is determined by frequency to be used. Standard adjustment of all registers is factory set at ± 1 bit from nominal unless otherwise specified when the drum is ordered. (Note: Customer electronics are required at the Bryant plant whenever special register adjustment is stipulated.)

ACCESS TIME—Standard Auto-Lift drums are available with access times ranging from 50.1 milliseconds (1200 RPM) to 5.0 milliseconds (12,000 RPM). (See selection chart above). Access times down to 1 millisecond (60,000 RPM) are available on special order.

RECORDING DATA—Signal characteristics for a Bryant Auto-Lift drum system are defined as follows:

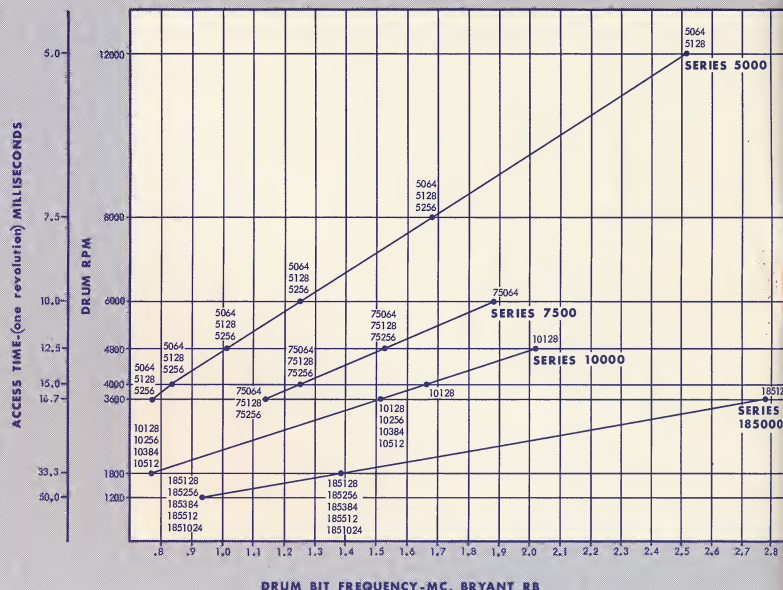
- Signal-to-noise-ratio is defined as the ratio of minimum all-ONE signals found anywhere on the drum to maximum noise after D-C erase.
- Track-to-track crosstalk is defined as the ratio of a minimum signal to maximum noise while reading D-C erased track after writing on the closest adjacent track.
- Modulation is calculated using the equation:

$$\% \text{ Modulation} = \frac{\text{Maximum Output} - \text{Minimum Output}}{\text{Maximum Output} + \text{Minimum Output}} \times 100$$

RECORDING MEDIA—Surfaces of standard Auto-Lift drums are plated with Bryant's super-finished, magnetic plating. This plating features:

- Low-friction, tough, abrasive-resistant surface.
- Extremely uniform playback and resolution characteristics over large drum surfaces.
- Low noise level.

MAGNETIC HEADS—Uni-Just aerodynamic heads are used to optimize drum performance through a broad range of operating frequencies and recording densities. Uni-Just heads are interchangeable and are adjusted with the drum in operation; thus heads may be replaced, if required, without taking the unit out of operation.



HEAD SPECIFICATIONS—Typical electrical and mechanical specifications for type AH020 Uni-Just Heads are as follows:

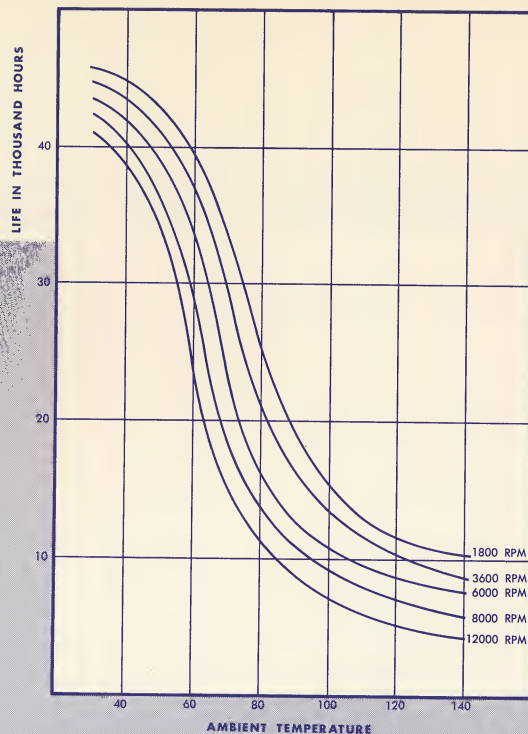
- Inductance (half coil)—17-24 microhenries at 140 kc
- D-C Resistance—1 ohm
- Drive Current—to fit application
- Balance (half coil to-half coil)—10%
- Resonant Frequency (half coil)—3.8 megacycles, minimum
- Track Width 0.020 inch
- Track-to-Track Spacing—0.035 inch
- Surface Speed Limits—900 to 4500 inches per second

HEAD WIRING AND CABLING—All head leads are taper-pin connected to terminal boards mounted on the head bars. All clock connections to external connectors on drum covers are provided with shielded cable.

MOTORS—All Auto-Lift drums are available equipped with induction motors (synchronous motors are optional) which have been Bryant-designed exclusively for drum applications. For 1200, 1800 and 3600 RPM speeds, motors require 60-cycle, 115- or 220-volt, single- or three-phase power; all motors with speeds above 3600 RPM require 400-cycle, 115- or 220-volt, single- or three-phase power. Motor stators can be replaced in the field within 30 minutes without resetting heads or losing data.

BEARINGS—Grade ABEC-9 bearings made of vacuum melted steel—the finest production bearings available—are used as standard equipment on all Auto-Lift drums. Bryant drum bearings are grease lubricated at the factory with Andok "C" lubricant to give the longest possible lubricant life for the operating conditions and environment specified. Because of its unique design, Bryant Auto-Lift drums permit bearings to be replaced in the field within four hours without resetting heads or losing data. (See bearing chart above.)

Auto-Lift drum selection chart. Speeds and frequencies given do not include motor slip. Nominal 800 bit-per-inch packing density is used to determine frequencies shown; bit interlacing permits the reduction of frequency while maintaining capacity. Substantially higher packing densities can be obtained using block-format recording.



Average bearing lubricant life using standard Andok "C" grease. The curve was made using the largest Auto-Lift drum designed to operate at each speed shown.

ENVIRONMENTAL CAPABILITY *

- Temperature
 - Operating: +32° to +120°F (0° to 49°C).
 - Non-operating: -65°F to +160°F (-54°C to 72°C).
 - Thermal Shock: Drum with covers in place will withstand 50°F step change while in operation.
 - Humidity: Up to 95 % R.H.
- Altitude
 - Operating: to 15,000 feet
 - Storage: to 50,000 feet
- Shock and Vibration
 - Shock: 5 G's in any plane with standard mounts
 - Vibration:
 - 0-10 CPS (at 5 Mil excursion)
 - 10-25 CPS (at 2 Mil excursion)
 - 25-50 CPS (at 1 Mil excursion)
 - Over 50 CPS (at 0.5 Mil excursion with the maximum acceleration of 2 G's)

RELIABILITY:

- Design life is 100,000 hours when Bryant recommended preventive maintenance procedures are used.

PACKAGING:

- Quick access panels on all four sides
- Vertical mounting
- Dust tight enclosure

PRODUCT ASSURANCE —Bryant Product Assurance means assuring that delivered products fully satisfy the purchase specifications with regard to capability, reliability and quality. A complete Product Assurance organization reporting directly to general management has been established to carry out this function. The responsibilities of this organization begin during equipment design when reliability engineering personnel assist in development of hardware specifications and component selection. This early effort is followed by rigid quality control activity which assures that vendors and the fabricating departments fully comply with the specifications. Quality Control also enforces adherence to production and assembly procedures and conducts preliminary and final acceptance test of the deliverable equipment. Finally, the product assurance organization is responsible for operational failure analysis and the required feedback to design engineering.

ACCEPTANCE TESTS:

- All acceptance tests are run at Bryant facility unless otherwise negotiated.
- Tests are to standard Bryant test procedures unless otherwise negotiated.

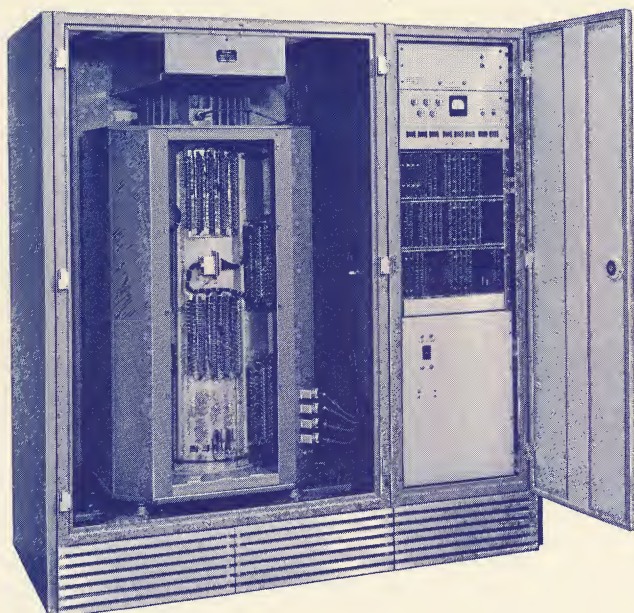
SPECIAL TOOLS —Tools for head setting are provided with the drum at time of shipment.

MAINTENANCE AND INSTRUCTION HANDBOOK —Two copies of the standard Bryant maintenance and instruction handbook are provided with each drum.

FIELD SERVICE—In addition to regularly assigned field service personnel, Bryant factory personnel can be dispatched promptly to meet customer field service requirements.

Service on Bryant drums and electronic systems can be obtained by contacting the Product Service Department at Walled Lake. Usually, servicemen are dispatched within 24 hours.

*Applies to standard units only. Drums meeting military requirements are available.



COMPLETE DRUM SYSTEMS—

Custom-designed memory systems—using standard circuit modules—can be built to give as much capability as desired, compatible with the memory equipment specified. Bryant will design an entire system around the customer's interface specifications of data rates, capacity, control signals, and modes of operation.

Simple systems incorporating only read, write and select amplifiers or more complex systems containing all address decoding, counters for address control and selection, shift registers for serial-to-parallel and parallel-to-serial conversion, and parity generation and checking can be readily designed and fabricated. Systems have been delivered which utilize up to 50-bit parallel recording, precession loops, and bit interlacing and discrete-bit alteration up to packing densities of 500 bits per inch. Phase modulation, RZ and return-to-bias recording systems are available.

ELECTRONIC COMPONENTS

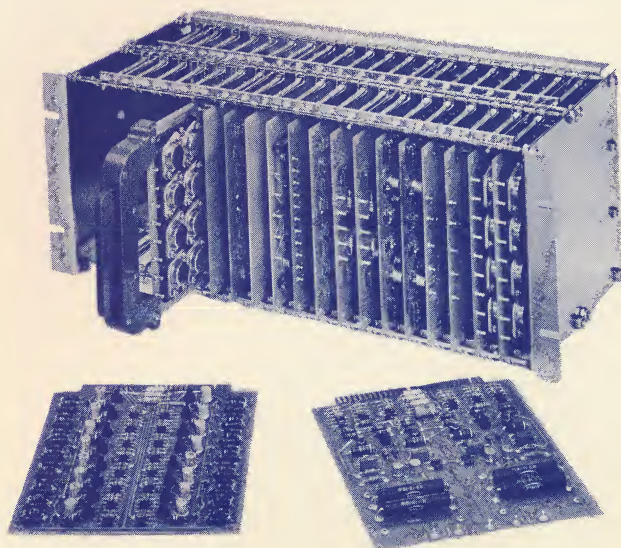
Bryant standard electronic modules are available to perform all of the read, write, clocking, head switching and logic functions required of a magnetic drum memory system. All are transistorized printed circuits mounted on glass epoxy cards; only the highest quality components are used.

Logic circuits are designed for 1 MC operation with rise and fall times less than 100 nanoseconds. All circuits have been worst-case designed for operation to temperature extremes from 0° to 55°C. Gold-plated connector tabs and connectors are used to ensure that all connections have maximum immunity to corrosion and minimum contact resistance.

Modules presently available include:

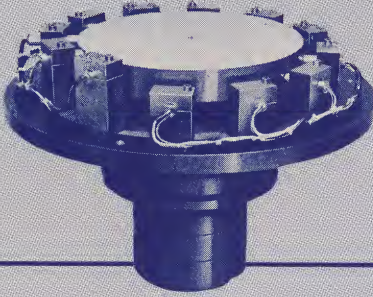
Read Amplifier 8005	Single-Shot 8055
Read Amplifier 8006	Gate Driver 8060
Write Amplifier 8010	Inverter Buffer 8061
Single-Head Select 8020	Flip-Flop 8070
Multi-Head Select 8025	Power Control 1 8081
Diode Gate 8030	Power Control 2 8082
Diode Matrix 44 8040	Power Control 3 8083
Nand Circuit 8050	Read Mode Switch 8090

Cards are mounted in 20-card frames using MIL approved connectors. The frames, which are designed for mounting in standard 19-inch racks, are fabricated with large open areas for unrestricted ventilation of the cards—a feature that increases the life of components.

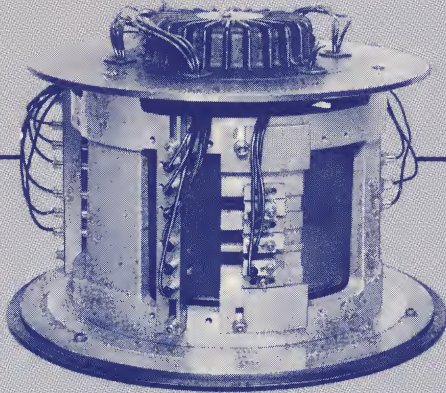


LOW-COST DRUMS

Low-cost drums are available from Bryant to meet the requirements of a wide variety of educational, laboratory, and commercial applications. Backed by more than 30 years of experience in the design and production of precision rotating devices, these low-cost units feature many of the high quality components found in Bryant standard and custom-design drums.



ECONOMY DRUM—The C-675 economy drum stores up to 29,400 bits on 12 tracks. Minimum playback signal is 15 mv. Standard speed is 1800 RPM.

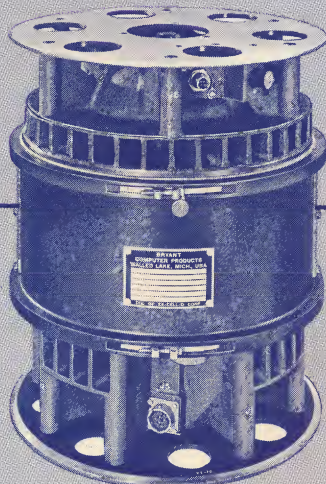


UTILITY DRUM—Bryant's C-105 utility drum offers maximum capacity of 400,000 bits on 100 tracks*. Standard speed is 3600 RPM, with 1800 RPM optional.

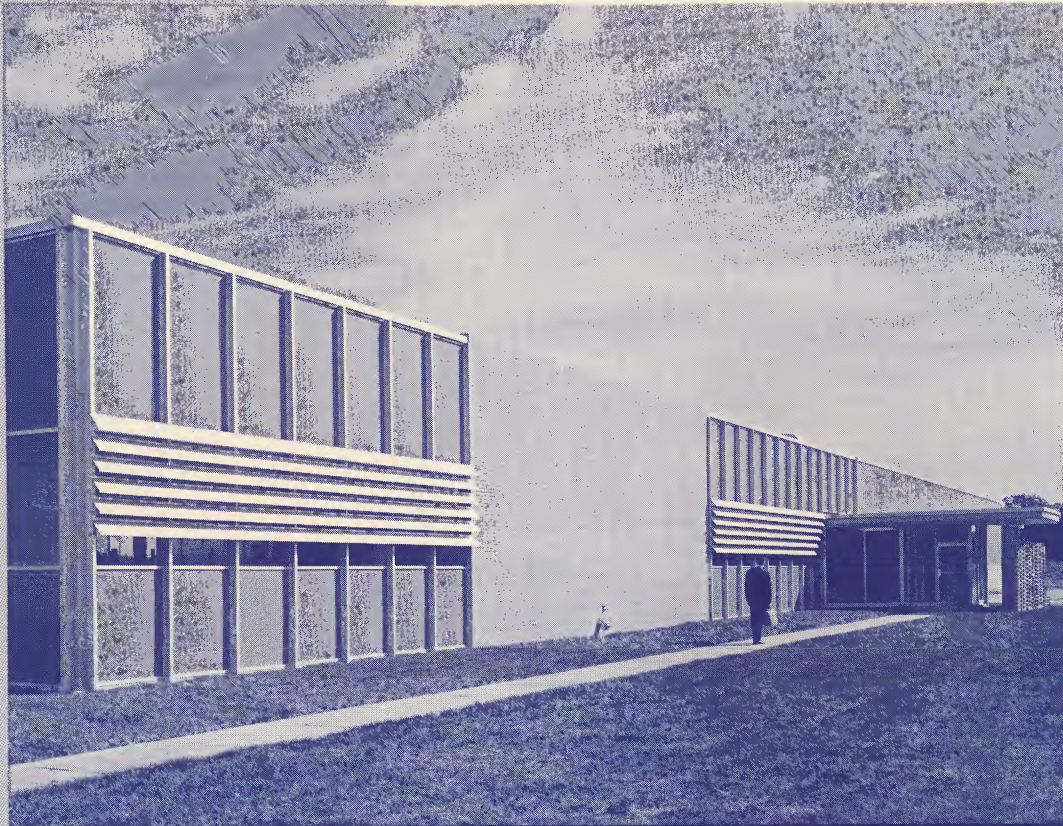
*Clock and register tracks, if required, will subtract from total storage.

CUSTOM-DESIGNED MEMORIES

Custom-designed drums and discs are available from Bryant Computer Products to fulfill the exacting specifications of the most advanced systems. Typical examples include drums ranging from 3" to 20" in diameter . . . air bearing drums with speeds to 120,000 RPM . . . analog recording units . . . low speed units to 2.5 RPM . . . high-speed discs . . . multi-speed units . . . and many others.



AIRBORNE DRUMS—Bryant has developed and produced airborne drums including the A-5003 (left) which meets the environmental and mechanical service requirements of MIL Spec. E-5400B for Class I Equipment. These units are available in capacities of 250,000 bits, with access times as low as 2.7 ms and frequencies in excess of one megacycle.



Bryant Computer Products' headquarters (shown above) are located at Ex-Cell-O Corporation's forty-acre Technical Center in Walled Lake, Michigan—a Detroit suburb. The division's sales and administrative staffs operate out of this facility, and all drum, disc file and electronic systems engineering, assembly and final testing are done here.

Ex-Cell-O Corporation—in publishing this brochure and its associated data—assumes no responsibility for any patent or other rights of a third party and no license is granted by implication, or otherwise, under any patent, patent rights or proprietary rights of Ex-Cell-O Corporation.

BRYANT COMPUTER PRODUCTS

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